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STIMULUS (INSTRUCTIONAL) FADING DURING EXTINCTION OF SELF-INJURIOUS ESCAPE BEHAVIOR

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Three individuals with developmental disabilities were exposed to a series of assessment conditions to identify the source of reinforcement for their self-injurious behavior. In each case, self-injury occurred most often in instructional (demand) situations containing a brief time-out from the task contingent on self-injury, indicating that the behavior was an escape response (i.e., maintained by negative reinforcement). Treatment was implemented in a multiple baseline across subjects design and consisted of extinction (prevention of escape) plus instructional fading (initial elimination of instructions followed by their gradual reintroduction). Results showed that the combined treatment produced immediate and large reductions in self-injury that were maintained as the frequency of instructions was increased across sessions to match the original baseline rate of presentation. Results of a component analysis conducted with 1 subject suggested that stimulus fading accelerated the behavior-reducing effects of extinction.

DESCRIPTORS: avoidance behavior, demand-frequency fading, escape behavior, extinction, negative reinforcement, self-injurious behavior, stimulus fading

Results from a number of studies on self-injurious behavior (SIB) indicate that one source of motivation for this disorder is negative reinforcement. For example, it has been shown that SIB in some individuals is correlated with the presentation of certain instructional (demand) situations (Carr, Newsom, & Binkoff, 1976), and that the removal of task requirements in the form of brief time-out contingent on the occurrence of SIB can produce increases in the behavior above baseline levels (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982). These and similar analyses of SIB as escape or avoidance behavior have illustrated the importance of developing therapeutic procedures that specifically eliminate or attenuate the contingencies that promote and maintain such behavior.

Two general approaches have been taken in the treatment of self-injurious escape. The first involves modification of antecedent stimuli that produce SIB; in effect, this represents removal of the behavior's establishing operation (see Michael, 1982, for further discussion of antecedent stimuli as establishing operations for escape). Carr et al. (1976) showed that demand cessation quickly terminated

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SIB, and Weeks and Gaylord-Ross (1981) demonstrated continued low levels of behavior problems when escape-producing stimuli ("difficult" tasks) were gradually faded into the training situation after initially being removed in favor of "easy" tasks. Other examples of task modification include various ways of alternating tasks during training sessions, as in "easy" versus "difficult" or "aversive" versus "reinforcing" (Horner, Day, Sprague, O'Brien, & Heathfield, 1991; Mace & Belfiore, 1990).

Because interventions based solely on the alteration of establishing operations do not affect the probability of reinforcement once behavior has occurred, there is the possibility that therapeutic effects might be achieved without having to interfere with the behavior's maintaining contingency. For example, *noncontingent* task reduction or modification may decrease the occurrence of escape behavior whether or not the behavior continues to be reinforced (i.e., whether or not episodes of SIB are followed by contingent task removal). The extent to which this outcome can be realized remains hypothetical, because research conducted to date has not evaluated instructional modifications with the escape contingency for SIB still in effect. This fact points to a possible limitation of treatments based solely on the rearrangement of antecedent conditions. If the occurrence of SIB continues to produce escape under the new arrangement (or while attempting a fading procedure), treatment effects may be compromised.

The second approach to treatment involves modification of the escape contingency for SIB. The most direct method is based on the principle of extinction applied to behavior maintained by negative reinforcement (Hineline, 1977), and typically involves continued presentation of events that occasion or produce SIB (e.g., educational tasks) while explicitly preventing escape from the ongoing situation. This form of "escape" extinction has been included as one of several components in the successful treatment of SIB (Heidorn & Jensen, 1984; Mason & Iwata, 1990; Repp, Felce, & Barton, 1988; Steege, Wacker, Berg, Cigrand, & Cooper, 1989). Iwata, Pace, Kalsher, Cowdery, and Cataldo (1990) recently conducted an extensive examination of escape behavior and demonstrated the effects of extinction with 7 self-injurious individuals. Data from that study also revealed a potential limitation of escape extinction: The decrease in SIB was preceded by an increase for 2 subjects, reduction was gradual for 3 subjects, and a high level of SIB persisted for over 20 sessions for 1 subject. These results are consistent with the "bursting" phenomenon often associated with extinction of behavior maintained by positive reinforcement.

In this study, we examined the benefits of combining antecedent and consequent approaches to the treatment of self-injurious escape behavior through the use of stimulus fading as an adjunct during escape extinction. Specifically, we wanted to see if a reduced rate of instructions at the outset of treatment would prevent the occurrence of an extinction "burst." In addition, the method of demand fading used here was different than that described by Weeks and Gaylord-Ross (1981). Rather than fading along the dimension of task difficulty, our fading procedure was based on frequency (Heidorn & Jensen, 1984); this procedure could be used in situations in which even "easy" tasks were found to produce SIB (e.g., Repp et al., 1988).

METHOD

Subjects and Setting

Three individuals participated. Mary was a 3-year-old female with severe mental retardation who was blind and had cerebral palsy. She did not have any self-feeding or dressing skills, was not toilet trained, and responded inconsistently to her name and other spoken instructions. Mary's mother did not recall the age of onset of Mary's SIB, and reported that it occurred "everywhere," but usually not while she was alone or in her bed. Wally was a 17-year-old male whose profound mental retardation was secondary to congenital rubella. He was ambulatory, followed a few one-step instructions, and had self-feeding and dressing skills. He did not speak, although he reportedly communicated through idiosyncratic gestures. Wally's mother and

teachers reported that his SIB had been a problem for many years; it occurred most often when he was "upset," and rarely occurred during mealtimes. Lynn was a 2-year-old female with moderate mental retardation. She walked independently and fed herself with assistance, communicated through gestures (pointing), and responded to her name, familiar objects, and some words. Lynn's SIB was first noticed about 6 months prior to her involvement in this study. Her parents were unable to identify any specific situations in which the behavior was most likely to occur. None of the subjects received psychotropic medication during the study.

All sessions lasted for 15 min and were conducted individually in therapy rooms equipped with a one-way observation window and furniture or materials as described below.

Response Measurement and Reliability

SIBs were defined as follows: ***head banging*** (Mary): forceful contact of the head against objects; ***scratching*** (Mary): raking movement of clenched fingers against the face or ears; ***eye poking*** (Mary): contact of a finger against the eyelid; ***self-hitting*** (Wally): forceful contact of the hand or fist against the face, head, or legs; and ***hand biting*** (Lynn): closure of upper and lower teeth on the fingers, hand, or arm. During each session, data were taken on SIB during continuous 10-s intervals using a hand-held computer (Panasonic Model RL-H1800 or Hewlett Packard Model HP-71B). During instructional sessions (see below), data also were collected on the frequency of instructions delivered by the experimenter and subjects' compliance with instructions, defined as completion of the task (without physical assistance for Wally and Lynn, and with only a touch prompt for Mary). Data were converted to percentage of intervals during which SIB occurred, frequency of instructions delivered per minute, and percentage of instructions with which a subject complied (percentage compliance).

Interobserver agreement was assessed by having a second observer simultaneously but independently collect data during 33%, 25%, and 51% of the sessions for Mary, Wally, and Lynn, respectively. Percentage agreement scores were calculated based on interval-by-interval comparison of the observers' records and dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Mean overall agreement scores for SIB, instructions, and compliance, respectively, were as follows: Mary: 97%, 93%, 98%; Wally: 95%, 95%, 92%; Lynn: 98%, 94%, 96%.

Experimental Sequence and Designs

The first phase of the study consisted of a functional analysis baseline, during which subjects were exposed to a series of conditions in a multielement design (Sidman, 1960; Ulman & Sulzer-Azaroff, 1975) in order to identify the maintaining variables for their SIB. A baseline condition was then initiated for each subject. One treatment condition, extinction of escape behavior, was implemented briefly and only with Lynn. A second treatment condition, extinction of escape behavior combined with instructional fading, was implemented with all 3 subjects in a multiple baseline across subjects design. Additional conditions, described below and implemented in reversal designs, were included for Wally and Lynn.

Functional Analysis

Subjects were exposed to four conditions. A brief description of each is provided here; more complete details can be found in Iwata et al. (1982, 1990). During the demand condition, an experimenter presented academic tasks to the subject in a discrete-trial format approximately once every 30 s, delivered praise contingent on correct responses, and implemented a 30-s time-out from the task contingent on the occurrence of SIB. During the attention condition, an experimenter instructed the subject to play with toys that were in the room and proceeded to do paperwork. Contingent on the occurrence of SIB, the experimenter delivered a verbal reprimand, expressed concern, and briefly interrupted the SIB. During the alone condition, the subject was observed while alone in the room, which was empty except for a chair. The final condition, play, served as a control for the other three. The experimenter provided access to toys, provided praise approximately every 30 s contin-

gent on the absence of SIB, and ignored occurrences of SIB.

Treatment Conditions

Baseline. This condition was identical to the demand condition during the functional analysis baseline. Educational tasks were selected based on the subject's level of functioning and current individualized educational plan. For Mary and Lynn, the tasks involved mostly touching responses (identification) and motor imitation (Lynn only); for Wally, the tasks involved picture identification, discrimination, sign language, and simple assembly. An experimenter initiated trials approximately twice per minute, delivered praise for compliance, and used a graduated prompting sequence for noncompliance. A 30-s time-out was implemented contingent on the occurrence of SIB.

Extinction. Instructions and praise continued as in baseline. The time-out for SIB, however, was eliminated. Instead, the experimenter continued to deliver instructions and physically guided the subject through the task contingent on SIB. By eliminating the possibility of avoiding, escaping, or postponing instructions and their associated task requirements, this condition amounted to extinction of escape behavior (Iwata et al., 1990).

Extinction plus fading. For the first few sessions, the experimenter ceased delivering any instructions and merely sat across the table from the subject without initiating any interaction. During these and subsequent sessions, subjects were free to manipulate materials, move about the room, and so on, during intertrial intervals. After completing a session during which no SIB occurred, the experimenter delivered one instruction during the next session (at approximately the midpoint of the session). Additional instructional trials were faded in during subsequent sessions, one at a time initially, based on the subject's level of SIB. No specific criterion was used to determine the increase in instructional rate across sessions, except that trials were not increased unless SIB showed a decreasing or stable trend. As in the extinction condition, the experimenter prevented the subject from escaping from the task by guiding the subject through the task contingent on the occurrence of SIB. The combined extinction-plus-fading procedure continued, with the rate of instructions equally spaced within a session, until the rate of instructions reached approximately two per minute, which equaled the prescribed rate during baseline.

Reversal procedures. Two additional control conditions were introduced during treatment for Wally and Lynn. A complete reversal to baseline contingencies—high instructional rate plus time-out (escape) contingent on SIB—was conducted with Wally. A partial reversal—a return to the previous condition consisting of a high instructional rate plus extinction—was conducted for Lynn.

RESULTS

Functional Analysis

Figure 1 shows the percentage of 10-s intervals of SIB across demand, attention, alone, and play conditions during the initial phase of the study. Patterns of responding were very similar for the 3 subjects; all exhibited high levels of SIB during the demand condition (with means exceeding 50%) and little or no SIB during the other conditions. These data are consistent with results from other studies using similar methods (e.g., Iwata et al., 1990; Steege et al., 1989; Sturmey, Carlsen, Crisp, & Newton, 1988), which showed that escape-motivated SIB increased when brief time-out from instructional trials followed occurrences of the behavior. More important, the data indicated that the demand condition would be the most relevant baseline for these subjects and that escape was the reinforcer that needed to be eliminated through extinction.

Effects of Treatment on SIB

Figure 2 shows the results obtained when extinction, with or without fading, was applied to SIB during a demand condition. Extinction plus fading was associated with large and immediate decreases in SIB for Mary and Wally compared to their baselines. When extinction alone was implemented with Lynn, her SIB became highly variable compared to baseline, although there was a slight

decreasing trend across the condition. This reduction in Lynn's SIB was apparently accelerated when the fading procedure was added to her treatment. It is important to note that the extinction-plus-demand-fading condition initially consisted of no instructions whatsoever, so that both extinction and fading were inactive components of intervention during the first three to five sessions, until a subject reached the point of exhibiting no SIB. Thereafter, escape was prevented as demands were gradually introduced.

When reversals consisting of a return to baseline (Wally) or an abrupt switch to a high-rate instruction condition (Lynn) were implemented, SIB increased once again, and decreased when extinction plus fading was resumed. By the end of treatment, instructions routinely were given at a rate of two per minute, while SIB remained low. These results compared very favorably with baseline. For example, Lynn's SIB averaged 56.3% during baseline and it was possible to deliver instructions at a rate of less than one per minute (M = 0.92). During the last 10 sessions of her treatment, SIB averaged 3%, and instruction rate was more than double that of baseline (M = 2.03 per minute).

Effects of Treatment on Compliance

All subjects became more responsive to instruction as their SIB decreased during treatment. Mean percentages of compliance during baseline and the last 10 sessions of the extinction-plus-fading condition were as follows: Mary: 42.2% versus 78.4%; Wally: 38.6% versus 78.6%; and Lynn: 5.0% versus 70.3%.

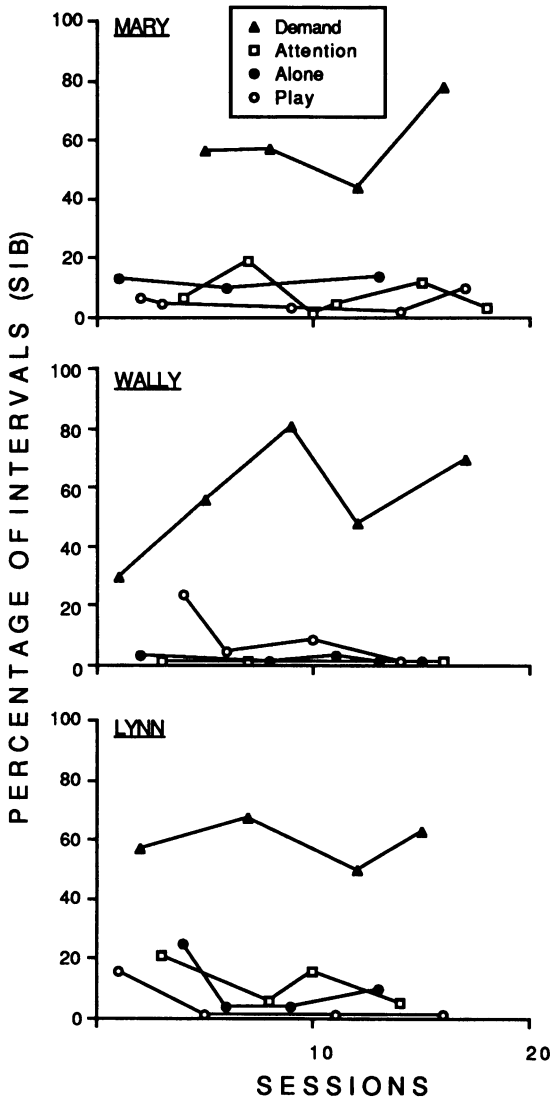

Figure 1. Percentage of 10-s intervals of SIB across assessment conditions during the functional analysis baseline.

DISCUSSION

The present results are consistent with those of previous studies on the extinction of self-injurious escape behavior (e.g., Iwata et al., 1990; Repp et al., 1988; Steege et al., 1989). An extension of these studies also is provided in that fading of instructional frequency was shown to accelerate the behavior-reducing effects of extinction. Support for the latter conclusion comes from two sources. First, unlike some of the results reported by Iwata et al. (1990), in which reductions in SIB were gradual or were preceded by bursts for some subjects, data for the 3 subjects in this study showed large and immediate decreases in SIB associated with the onset of extinction plus fading. Second, a within-subject comparison was conducted with Lynn, for whom it was demonstrated that extinction plus fading produced a more rapid reduction in SIB than did extinction alone.

Although the data reported here are promising, they should be considered tentative. It is important

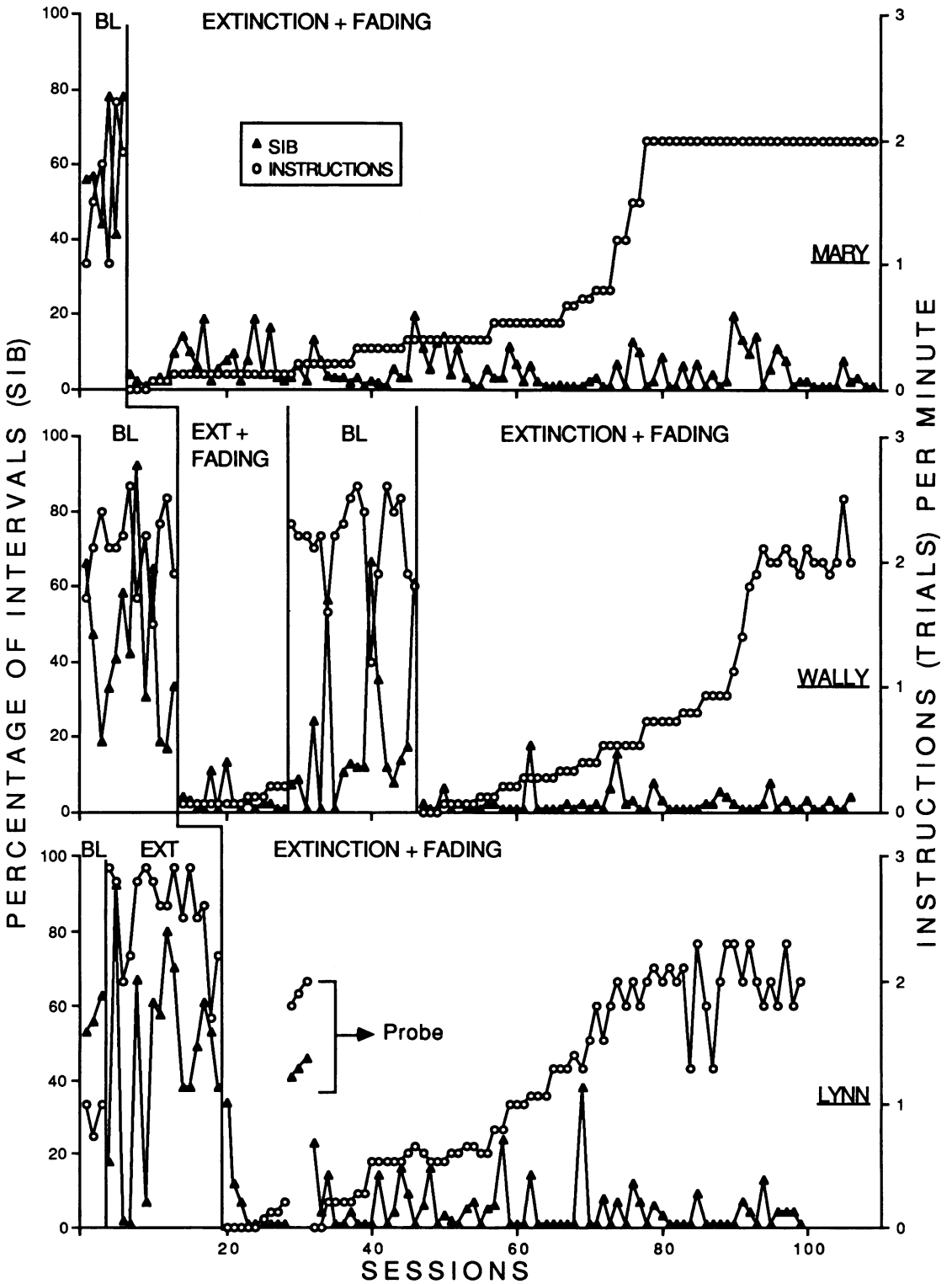

Figure 2. Percentage of 10-s intervals of SIB and frequency of experimenter instructions delivered per minute during baseline and treatment conditions.

to note that the potential superiority of extinction plus fading was demonstrated with only 1 subject and only during the initial sessions of treatment. It is possible, for example, that if extinction alone (with a high rate of instructions) were continued for Lynn, her SIB would have reached its end-of-treatment level faster than with extinction plus fading, because the ultimate criterion for successful treatment is reduced SIB within the context of an ongoing instructional situation. Thus, additional comparisons are needed and perhaps will require the use of multiple outcome criteria (e.g., rapidity of initial reduction in SIB, end-of-treatment level of SIB, final instructional rate, compliance, etc.). The results of such comparisons may indicate different benefits associated with different methods of treatment. For example, if extinction plus fading requires lengthy treatment but produces no extinction burst, it would be appropriate for use with individuals whose SIB has the potential for causing significant tissue damage. On the other hand, if extinction alone produces an initial burst followed by more rapid elimination of SIB than when used with fading, it should be considered when the risk associated with the behavior is rather low.

One limitation of the present study is that no attempt was made to establish an alternative form of escape behavior in our subjects. Although one might consider it inappropriate to reinforce any attempts to terminate important and needed instruction, the treatment of self-injurious escape behavior through extinction does not result in development of a response that might be used to terminate other forms of aversive stimulation. The reinforcement of escape behavior during training contexts (e.g., as in Carr & Durand, 1985; Day, Rae, Schussler, Larsen, & Johnson, 1988; Steege et al., 1990; Wacker et al., 1990) might be considered an initial method for establishing appropriate forms of escape, which can then be transferred to other contexts.

It has been noted previously (Iwata et al., 1990) that the extinction procedure contained two changes from the baseline condition. First, SIB no longer produced escape from instruction; second, physical guidance (an inevitable consequence of nonconpliance) immediately followed SIB. It is possible that the latter component may be viewed as a punishment contingency; however, Lynn's data during the initial extinction condition and the subsequent probe are more consistent with an extinction interpretation.

Given the present results when extinction was combined with fading and the results of previous research demonstrating the efficacy of extinction without fading, future research should examine the effects of fading as a singular form of treatment. Studies cited earlier, in which antecedent instructions were modified, all included an extinction component for escape behavior (Horner et al., 1991; Mace & Belfiore, 1990; Weeks & Gaylord-Ross, 1981). Moreover, in the only study including a fading component (Weeks & Gaylord-Ross), careful examination of the data shows decreasing trends in inappropriate behavior even during baseline (difficult task) conditions. Thus, it is unlikely that stimulus fading alone accounted for the results. In addition, because some inappropriate behavior continued to occur during fading conditions, one would expect it to be strengthened (reinforced) if it were followed by termination or postponement of instructional trials, or possibly by switching from difficult to easy tasks. The fact that inappropriate behavior occurred at low levels but did not increase as escape-producing stimuli were faded in suggests the operation of some other variable (probably extinction) to prevent adventitious reinforcement.

Additional considerations for future research include the use of fading along multiple dimensions (i.e., frequency and difficulty), highly salient escape or avoidance contingencies for appropriate behavior to strengthen compliance with instructions, and the evaluation of alternative methods for establishing behavior that competes with escape responding (e.g., see Mace & Belfiore, 1990, for an interesting example of treatment based on the phenomenon of "behavioral momentum"). These and other approaches to the functional analysis and treatment of behavior disorders should result in an expanded range of therapeutic procedures uniquely suited to problems maintained by negative reinforcement, an area of considerable importance given the heavy

emphasis placed on behavioral acquisition for individuals with extensive behavioral deficits and the fact that acquisition training inevitably contains an effort component that may have aversive qualities (Iwata, 1987).

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